

STUDIES AND RESEARCH CONCERNING INDEPENDENT DISC HARROWS

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ABSTRACT

Equipments for seedbed preparation equipped with independent disks achieved qualitative indices that agro requirements imposed, especially for crops that are established in autumn. Independent disc harrows are simple in constructively and are safe in operation.

From arable land, about 37% is busy by crops that are established in summer-autumn, the rest arable land being for spring crops.

Seedbed preparation with light disc harrow leads to: higher fuel consumption, increasing of employment, increasing the duration of the campaign and the execution of an inadequate seedbed in conditions of low soil moisture.

INTRODUCTION

In this context, it promotes a disc harrow and organs (additional) for shredding, destined for 120 -160 hp tractors, in order to improve stubble technology and seedbad preparation on the fresh plowing on which has been set up summer-autumn crops.

Soil works performed by independent disc harrows are characterized by good results of shredding, mixing and mobilization of soil, carried out under a low humidity of the soil (Cojocaru I. et al., 2000).

From constructive and functional point of view, disc harrows has the advantage of easily pass over any obstacles that appear in working process, and the spherical active disks, have a low degree of wear (due to the fact that the requests in the work process are distributed along the length of the cutting edge) (Alexandru T. and M. Glodeanu, 2009).

MATERIAL AND METHODS

➤ Presentation of the experimental variant

Independent disc harrow TERRA DISC 300 manufactured by the company Vogel & Noot executed in a single pass, seedbed preparation in fresh plowing, or unploughed land, where crops are established (to sowing grain cereals and weeding plant, at depths ranging from 5 to 10 cm). Is used on fresh plowing in all types of soil found on flat land, or with a slope to 6 °. Plowing must harrowing as soon as they were made, because these became harden, can not be mince and increase water loss through evaporation.

Independent disc harrow TERRADISC 300 (fig. 1) is a towed agricultural equipment at lateral thrusts (category II SR ISO 730-1 + C1: 2000) of tractors of 120-160 hp.

From the constructive point of view, harrow comprises a frame on which are mounted set of disks, the bar with elastic fingers and the roller for grinding and leveling the soil.

The harrow frame is a welded metal construction, in the form of a rectangle, rigidified with reinforcement plates.



Fig.1. Independent disc harrow TERRADISC 300 manufactured by the company Vogel & Noot.

Battery with disks (front + rear) includes two batteries arranged in two rows with a angle of inclination to the direction of travel of 17° , respectively 23° . Batteries consist of flat disks, roller bearings, shaft mounting and boom support. The discs have an external diameter of 460 mm and are made of manganese sheet metal (fig. 2).



Fig. 2. The layout of the batteries with disks.

The attaching of disks on the frame is made through cylindrical roller rubber, which provides elasticity, but also a permanent vibration of disks (which contributes to reduction the tensile strength and fuel consumption reported to the area worked). In the same time is ensured crossing over any obstacles emerged during operation.

Shredding and leveling roller is mounted behind the disc batteries in order to mince, leveling and replace processed soil by the the batteries of the harrow (fig. 3).



Fig. 3. Shredding and leveling roller.

➤ Test method

In the tests were determined or calculated in accordance with the procedures in force, following indices (Alexandru T. and M. Glodeanu, 2009; Cojocaru I. et al., 2000; Glodeanu M., et al., 2015):

a) **Qualitative indexes of work:**

1) Average working depth (a_m) in cm. It is calculated with the following relation:

$$a_m = \frac{\sum_{i=1}^n a_i}{n} \quad [\text{cm}] \quad (1)$$

where: a_i is the working depth, measured in cm;

n - number of measurements performed.

2) Average width (B_m) in cm, with aid of relation:

$$B_m = \frac{\sum_{i=1}^n B_i}{n} \quad [\text{m}] \quad (2)$$

where: B_i is the working width, measured in m;

n - number of measurements performed.

3) The shredding soil degree (G_{ms}) in %.

The main indicator of the work quality is the shredding degree of soil. For determination was delimited a soil sample with size of 1m x 1m (using metric frame). From the sample were separated soil fractions with size of less than 50 mm, from the lumps with size larger than 50 mm.

Shredding soil degree is the proportion by weight of soil fractions with a satisfactory shredding, respectively lumps with the size of maximum 50 mm (reported to the total weight of the soil sample). It is calculated using the following equation:

$$G_m = \frac{\sum_{i=1}^n \frac{M_{ci}}{M_{ti}}}{n} \cdot 100 [\%] \quad (3)$$

where: M_{ci} is the measured weight of the lumps of soil with maximum conventional size less of 50 mm, from the soil sample [kg];

M_{ti} – the measured weight of the whole soil samples taken [kg].

Weighings have been performed with a portable scale, with a permissible relative error of 1%.

4) The destruction of plant debris degree, in %. It is calculated using the relation :

$$G_v = \frac{\sum_{i=1}^n \frac{G_{ti} - G_{Si}}{G_{ti}}}{n} \cdot 100 [\%] \quad (4)$$

where: G_{Si} is the measured weight of remained plant mass on the soil surface, from the sample taken after switching equipment, in g;

G_{ti} - total weight of plant mass from the ground surface measured before switching equipment, in g.

n - number of measurements performed;

5) Soil loosening degree in %. Is determined with relation:

$$G_{as} = \frac{\sum_{i=1}^n \frac{h_1 - h_2}{h_2}}{n} \cdot 100 [\%] \quad (5)$$

where: h_1 is the distance to the ground before disking, in cm;

h_2 - the distance to the ground after disking, in cm.

b) Energy indices:

1) Effective working speed (V_e) in km / h. It was calculated using the relation:

$$V_e = \frac{3,6s}{t} [\text{km/h}] \quad (6)$$

where: s is the covered linear space, in m;

t - travel time of the covered space, in s;

2) Fuel consumption per hectare (q) in l / ha. It was calculated with the relation:

$$q = \frac{Q}{W_{ef}} [\text{l/ha}] \quad (7)$$

where: Q - is the hourly fuel consumption in l/h;

W_{ef} - hourly work capacity at effective time, in ha/h.

3) Hourly work capacity at the effective time (W_{ef}), in ha / h. It was calculated with the relationship:

$$W_{ef} = 0,1 B_m v [\text{ha/h}] \quad (8)$$

where: B_m is the average working width, in m;

v – real working speed in km/h.

RESULTS AND DISCUSSIONS

Tests under laboratory and field conditions-operation were carried out in aggregate with tractor JOHN DEERE, during April 2015- October 2016 in accordance with specific test procedures PSpl-01.10.29 "The test disc harrows" and PSpl-01.00.33 "Determination of energy indices for agricultural aggregates".

Field tests - lab were performed in the following conditions:

- Soil type – mold;
- Previous culture; - wheat, beans, peas;

Autumn tests were performed with soil moisture in 0...10 cm layer of 12,9% (fg. 4).

Spring tests were performed at a soil moisture of:

- 0 – 10 cm – 16...18 %;
- 10 – 20 cm – 15...17 %;
- 20 – 30 cm – 14...16 %.



Fig. 4. Aspects during working with independent disc harrow TERRA DISC 300.

The main qualitative indices of work achieved are presented in table 1.

Table 1

Qualitative indices of work achieved by independent disc harrow TERRA DISC 300

Qualitative indices of work	U.M.	Autumn-ploughed field	Spring-ploughed field	Spring-unploughed field
Averagedepthwork a_{med}	cm	6,7	8,2	6,1
Averageworkingwidth B_{med}	m	2,87	1,91	2,92
Shreddingsoildegree G_m	%	85,6	92,7	90,3
The degree of incorporation in soil of crop residues G_v	%	95,3	96,7	97,8
Soillooseningdegree G_{as}	%	18,7	24,5	20,7

Analyzing the data from table 1 is found that the achieved work indices are:

- averagedepthwork a_{med} = 6,7...8,2 cm;
- averageworkingwidth B_{med} = 2,87...2,92 cm;

In figure 5 is presented the graph of working variation indices of TERRADISC 300 harrow.

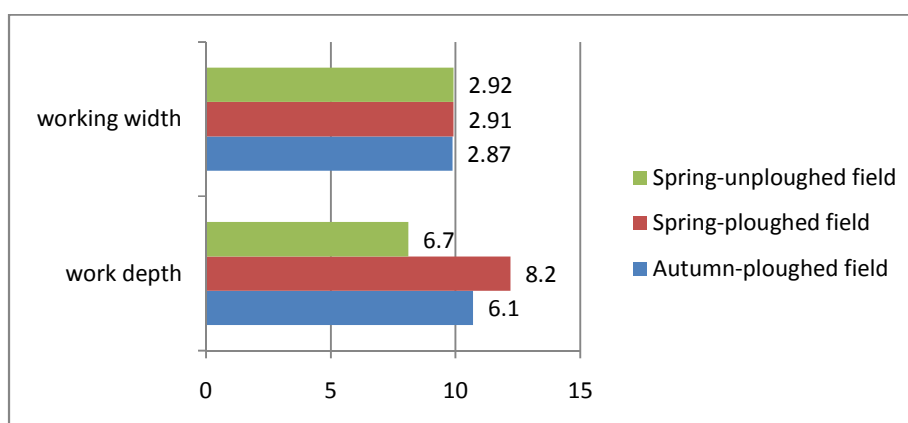


Fig. 5. Working variation indices of TERRADISC 300 harrow.

From the graph presented in figure 5, it can be observed that effective working width of the harrow has an insignificant reduction (0.8-1,13 %,) of the theoretical value of 3 m.

Concerning the working depth is found that for unploughed field, we have the lowest value of 6.1 cm. The greater value of 8.2 cm is obtained for field plowed in autumn and processed with the disc harrow in the spring (when the soil is processed for establishment of the sunflower crop).

Concerning quality indices work is found that (fig. 6):

- shredding soil degree $G_m = 85,6 \div 92,7\%$;
- the degree of incorporation in soil of crop residues $G_v = 95,3 \div 97,8\%$;
- soil loosening degree $G_{as} = 18,7 \div 24,5\%$.

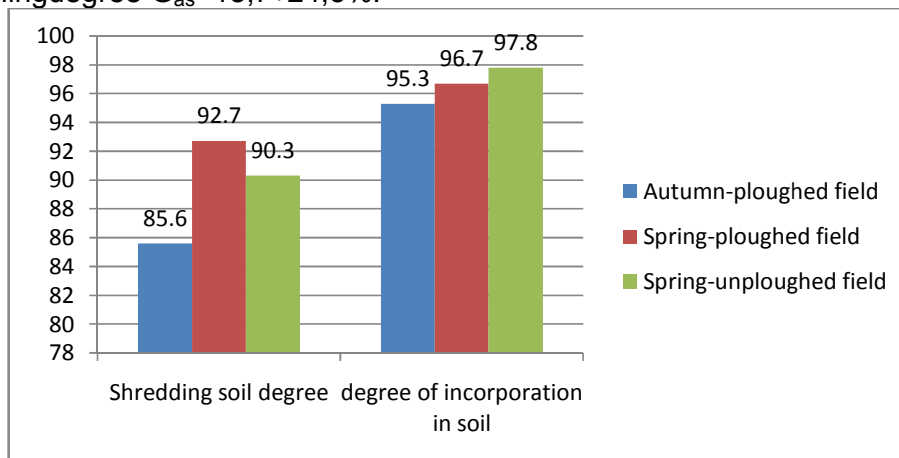


Fig. 6. Working variation indices of TERRADISC 300 harrow.

Analyzing data recorded is found that, from the point of view of the shredding of soil, agro-technical conditions are fulfilled, the values being over 85%. The lowest value was recorded in autumn, when soil moisture was lower compared with levels achieved in spring, when the values has been exceeding 90%.

The main energy indices achieved by the individual disc harrow TERRADISC 300 are presented in table 2.

Table 2

Energy indices achieved by the individual disc harrow TERRADISC 300

Energy indices	U.M.	Autumn-ploughed field	Spring-ploughed field	Spring- unploughed field
Work speed v_l	km/h	11,17	12,45	13,35
Working capacity at the effectively time: W_{ef}	ha/h	2,12	2,7	3,45
Fuel consumption Q	l/ha	5,31	4,86	3,58

Figure 7 present the graph of variation of energy indices achieved by the individual disc harrow TERRADISC 300.

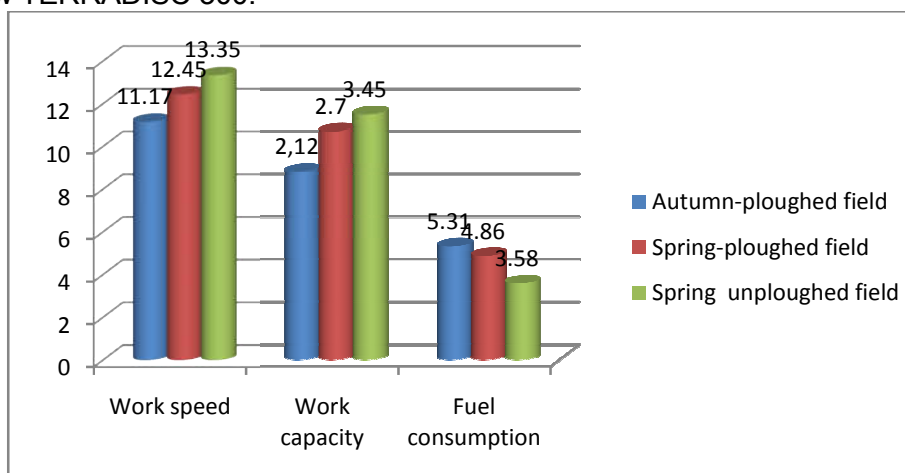


Fig. 7. The variation of energy indices achieved by the individual disc harrow TERRADISC 300.

Analyzing the data from table 2 it follows that:

- work speed $v_e = 11,17 \dots 13,35$ km/h;
- working capacity at the effective time: $W_{ef} = 2,12 \dots 3,45$ ha/h;
- fuel consumption $Q = 3,58 \dots 5,31$ l/ha.

The data presented in figure 7 shows that independent disc harrow ensures high working speeds compared with aggregates which equip agricultural holdings in the area (which operate with Romanian machinery). Also we find that there is provided a high hourly productivity of 3,45 ha for a fuel consumption of 3,58 l/ha.

CONCLUSIONS

From the analysis of data obtained in the tests resulted the following conclusions:

- Independent disc harrow TERRADISC 300 for 160 hp tractor was performed with two batteries in parallel and with additional shredding organs, with working width of 3,0 m;
- Independent disc harrow TERRA DISC 300 is used in summer-autumn (spring in certain situations) on fresh plowing, in all types of soil located on the flat land, or slope to 6°;
- Independent disc harrow TERRA DISC 300 is robust, simple in terms of construction and functionally, easy to handle, maintained and operated in the working process;
- This harrow is of the carried type, coupling operation being performed by the one man;
- Independent disc harrow TERRA DISC 300 performed quality work, with a high shredding degree of the soil and high values of the degree of incorporation in soil of crop residues;
- Regarding the energy point of view independent disc harrow TERRA DISC 300 achieve a equal fuel consumption (compared with GDU 3,4 harrow), considering that work capacity is two-fold.

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